

Survey Evaluation of Three Poliomyelitis Immunization Campaigns

ROBERT E. SERFLING, Ph.D., and IDA L. SHERMAN, M.S.

IN THE 7 years since the advent of Salk inactivated poliomyelitis vaccine and the more recent development of Sabin oral vaccine, city and county health officers have been challenged by the problem of measuring the effectiveness of communitywide immunization programs.

In many communities mass campaigns have been programed without adequate plans to assess their effectiveness. Evaluation of results has frequently been based on number of doses of vaccine used in the campaign without correction for wastage and other losses. Such losses, sometimes as high as 25 percent, may lead to overestimates of acceptance. In addition, a communitywide figure fails to reveal variations in participation by various segments of the community, as well as differences in response by age groups. To obtain this important information, counting participants through use of registration cards has frequently been attempted. Effective analysis of the cards has rarely, if ever, been accomplished. Deciphering the hastily completed clinic records, often illegible and frequently incomplete,

is a discouraging task. The frustration and delay attending this procedure often results in postponement of analysis until interest wanes, and the project is then shelved.

A quite different and wholly practical method of evaluation is the sample survey (1). This can be undertaken immediately after a program is completed. Preliminary results can be available within a week, and detailed final results, within a month. A few health department employees can collect the information in 2 or 3 days.

The survey technique was used to evaluate mass vaccination programs in Columbus and Atlanta, Ga., and in Syracuse, N.Y. These vaccination campaigns had been carried out in different "polio" climates: in Columbus, during a normal spring with no poliomyelitis reported in the community; in Atlanta, in early summer after 4 cases were reported from a circumscribed area of the city; and in Syracuse, during late summer after 20 poliomyelitis cases had occurred in the city and adjacent counties. The evaluation surveys were conducted by the respective city health departments, in cooperation with the Public Health Service's Communicable Disease Center, following distribution of the vaccine.

Surrounding counties were included in the Atlanta and Syracuse immunization programs, but the survey results presented here are confined to the cities. In all three programs, vaccine was distributed without charge, and extensive efforts were made to provide numerous distribution points at convenient locations.

In Columbus, an attempt was made to saturate the community with inactivated polio vaccine. Three injections were made available at

Dr. Serfling is chief and Ida Sherman, assistant chief, Statistics Section, Epidemiology Branch, Communicable Disease Center, Public Health Service, Atlanta, Ga. Dana Quade, Ph.D., Paul Levy, M.S., and Jesse Arnold, A.B., Epidemic Intelligence Service statisticians, Statistics Section, assisted with technical direction of the surveys. Sara Wingo, statistical assistant, supervised tabulation of the data.

Cooperating in these studies were J. F. Hackney, M.D., the late James A. Thrash, M.D., and D. E. Bigwood, M.D., health officers of Atlanta and Columbus, Ga., and Syracuse, N.Y., respectively.

monthly intervals during the spring of 1961, a time of normally low incidence of poliomyelitis. Mobile clinics using jet injectors distributed the vaccine during weekdays. The program engaged the attention of more than 20 persons for a period of more than 3 months and received maximum cooperation on the part of city and Public Health Service personnel. Columbus news, radio, and television facilities publicized the campaign widely, and the city government, civic leaders, and the Public Health Service participated enthusiastically.

In Atlanta, the appearance of four cases of type 3 poliomyelitis by early June 1961 forewarned of an epidemic, and type 3 oral vaccine was supplied by Dr. Albert B. Sabin for distribution to persons under 15 years of age. The program was conducted under the joint sponsorship of the State department of health and local health departments of the metropolitan area of Atlanta, and was directed primarily to the middle and lower socioeconomic population groups. There was reasonable spontaneity in participation at the clinics due to the publicity given the threatened epidemic. Organized clinics were held on weekdays, except for isolated instances in which a public health nurse distributed the vaccine at selected churches in the lower socioeconomic area.

An emergency program was initiated in Syracuse along with portions of Onondaga, Madison, and Oneida Counties after approximately 20 cases of paralytic poliomyelitis, including 12 in the city of Syracuse, had occurred in the area (2). The vaccination program began on Wednesday, August 29, and continued through Friday, August 31. On the evening of August 28, newspapers in the city had carried an announcement of the death, due to poliomyelitis, of a 32-year-old, unvaccinated white male in nearby Oneida County.

Methods

The Communicable Disease Center developed a quota sampling survey technique in 1958 for use in ascertaining the need for selective local immunization programs (1). The technique was used in some 125 leading cities of the United States. It was specifically directed toward obtaining an estimate of the proportions

vaccinated, by age groups, in demarked socioeconomic areas of the city. The primary objective was to provide comparisons of vaccination levels within the cities and thus detect "soft spots" requiring remedial action. As mass immunization progressed, estimates of total doses distributed in the city became of interest, and more generalized sampling procedures became necessary.

An area probability sampling scheme employing city blocks as primary sampling units was used in the three surveys. The blocks were allocated to census tracts in proportion to the population density within the tract. Within blocks, a systematic random sample of one-fourth of the housing units was selected. Table 1 presents data on sample size, city population, and completion of interviews at housing units selected for the sample.

To study response in the various socioeconomic areas of the three cities, census tracts were ordered by socioeconomic rank and then grouped by quartiles. One-fourth of the tracts were classified as upper, one-half as middle, and one-fourth as lower socioeconomic areas. Procedures for classifying the tracts in the three cities differed somewhat since the completed

Table 1. Survey data

	Columbus, Ga.	Atlanta, Ga.	Syracuse, N.Y.
Date of survey, 1961---	June	July	November
City population, 1960---	116, 779	144, 123	216, 038
Number blocks visited---	174	169	56
Approximate number blocks in city-----	1, 470	14, 380	1, 990
Number housing units visited-----	1, 371	1, 080	576
Number occupied housing units-----	1, 261	956	550
Number interviews completed-----	1, 177	891	528
Percent completed---	93. 3	93. 2	96. 0
Number interviews completed---			
On first visit-----	896	684	372
By telephone-----	175	143	140
On revisit-----	106	64	16
Number occupied housing units not interviewed:			
Not reached-----	67	60	9
Refusal-----	2	4	10
Other reason ² -----	15	1	3

¹ Fulton County only, excluding business area.

² Families on vacation, illness in family, and other.

Table 2. Vaccination status before and after inactivated vaccine program, Columbus, Ga., April-May 1961

Age group	Socioeconomic group	Number persons in sample	Percent with indicated number of doses					
			0		1 or 2		3 or more	
			Before	After	Before	After	Before	After
Under 5 ¹	Upper.....	147	8.9	5.4	21.1	17.7	70.1	76.9
	Middle.....	229	17.9	10.9	17.5	20.5	64.6	68.5
	Lower.....	215	28.4	15.8	25.1	27.0	46.5	57.2
5-14.....	Upper.....	268	.8	.8	4.1	2.6	95.1	96.6
	Middle.....	345	3.8	.9	7.0	7.2	89.3	91.9
	Lower.....	371	8.6	1.3	12.4	7.3	79.0	91.4
15-39.....	Upper.....	393	25.2	12.5	10.9	12.2	63.9	75.3
	Middle.....	605	28.4	16.4	13.1	14.9	58.5	68.8
	Lower.....	519	54.9	26.2	9.4	18.9	35.6	54.9
40 and over.....	Upper.....	256	78.9	64.9	5.5	10.5	15.6	24.6
	Middle.....	380	88.4	69.5	3.9	8.4	7.6	22.1
	Lower.....	492	94.3	63.2	1.8	10.6	3.9	26.2

¹ Excluding 21 infants under 3 months.

Table 3. Vaccination status before and after oral vaccine program,¹ Atlanta, Ga., June 1961

Age group	Socioeconomic group	Number persons in sample	Percent giving history of 3 or more doses of inactivated vaccine	Percent receiving type 3 oral vaccine during program	Percent with neither inactivated nor oral polio vaccine
Under 5 ²	Upper.....	25	76.0	72.0	4.0
	Middle.....	174	50.2	77.6	12.1
	Lower.....	82	30.1	76.2	15.9
5-14.....	Upper.....	71	97.1	53.9	0
	Middle.....	395	72.1	78.4	4.8
	Lower.....	184	41.8	75.9	10.3

¹ Oral vaccine limited to children under 15.

² Excluding 13 infants under 3 months.

Table 4. Vaccination status before and after oral vaccine program, Syracuse, N.Y., August 1961

Age group	Socioeconomic group	Number persons in sample	Percent giving history of 3 or more doses of inactivated vaccine	Percent receiving type 1 oral vaccine during program	Percent with neither inactivated nor oral vaccine
Under 5 ¹	Upper.....	32	71.9	100.0	0
	Middle.....	100	71.0	91.0	3.0
	Lower.....	60	50.0	88.3	1.7
5-14.....	Upper.....	62	100.0	93.5	0
	Middle.....	162	89.5	92.6	2.5
	Lower.....	113	65.5	96.5	.9
15-39.....	Upper.....	95	81.0	85.3	5.3
	Middle.....	278	57.2	83.5	8.6
	Lower.....	149	42.3	81.9	12.8
40 and over.....	Upper.....	147	7.5	30.6	67.3
	Middle.....	365	7.1	35.1	63.0
	Lower.....	171	6.4	40.4	58.5

¹ Excluding 8 infants under 3 months.

1960 census tract data were not available when the surveys were made. In Atlanta, advance copies of tables from the 1960 census tract data (3) were used. In Syracuse, 1960 city-block statistics (4) were used with some adjustments for correspondence with previous sociological studies by Dr. Charles V. Willie, department of sociology, University of Syracuse, which were described during personal discussions. In Columbus, the Hollingshead two-factor index of social position (5) was computed for each survey family, and average values were calculated for each census tract after the survey was completed. Interviewing in Columbus and Atlanta was done by Communicable Disease Center staff members, augmented by local health department personnel, and in Syracuse entirely by health department nurses and sanitarians.

To illustrate the work and time required to plan and conduct a survey of this type, initial planning in Syracuse required 1 week and was carried out by two consultant statisticians from the Communicable Disease Center. Fieldwork was completed in 3 days by four teams, each consisting of two health department nurses. One or two nurses worked each evening on telephone callbacks, and two sanitarians revisited families who could not be reached by telephone.

Results

Tables 2, 3, and 4 show survey data for each city, including status with respect to inactivated poliomyelitis vaccination before the mass immunization campaign. For Columbus, the data show the percentage of persons with three or more inactivated polio vaccine injections before and at the close of the campaign. The data for Atlanta show the percentage of persons under 15 years of age who obtained a single dose of type 3 oral vaccine, and for Syracuse, the percentage of persons who obtained a single dose of type 1 oral vaccine. The results are summarized in the chart.

In Columbus, a small increase occurred in the percentage of preschool children under 5 with three or more injections. However, in the middle and lower socioeconomic groups the response was not sufficiently great to raise the proportion with three or more doses to that of children in the upper socioeconomic groups.

In Atlanta and Syracuse, a much better response to the single-dose oral vaccine program was observed among preschool children in the middle and lower socioeconomic groups. Prior differences in immunization levels by socioeconomic groups were not reflected in the percentages receiving the single dose. The percentages, however, were higher in Syracuse than in Atlanta.

Discussion

The results of the three surveys provided the respective health departments with crucial information on response by age and socioeconomic area for subsequent intensified, localized programs within the cities.

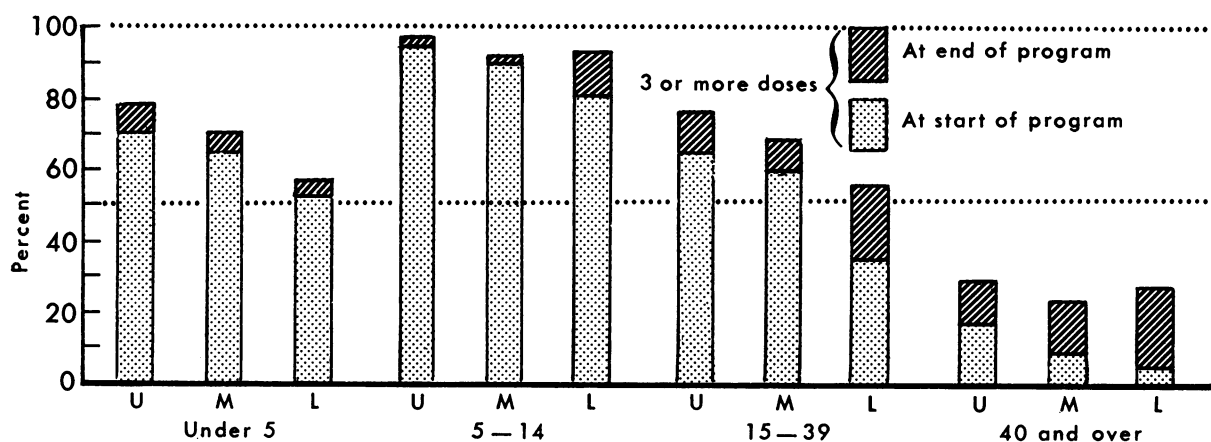
The surveys allow one obvious conclusion: The threat of a poliomyelitis epidemic is a powerful stimulus to participation in a mass immunization program. Best response was in Syracuse, where an epidemic of poliomyelitis type 1 was threatening. Next best response was in Atlanta, where the appearance of a few cases in a localized sector of the city apparently aroused interest in the distribution of type 3 oral vaccine. Poorest response was in Columbus, where no cases of poliomyelitis had occurred for 18 months.

The best prior inactivated poliomyelitis vaccine coverage was in the upper socioeconomic segments of all three cities. In the oral programs, differences by socioeconomic level generally were negligible, except for lower response by the upper socioeconomic children of school age in Atlanta. In Atlanta's program, pediatricians frequently did not recommend oral vaccine for children who had been well immunized with inactivated vaccine. No attempt was made by the health department to "sell" the program to the pediatricians, since the objective of the campaign was to reach those segments of the population more closely associated with the area in which the few cases of poliomyelitis had occurred.

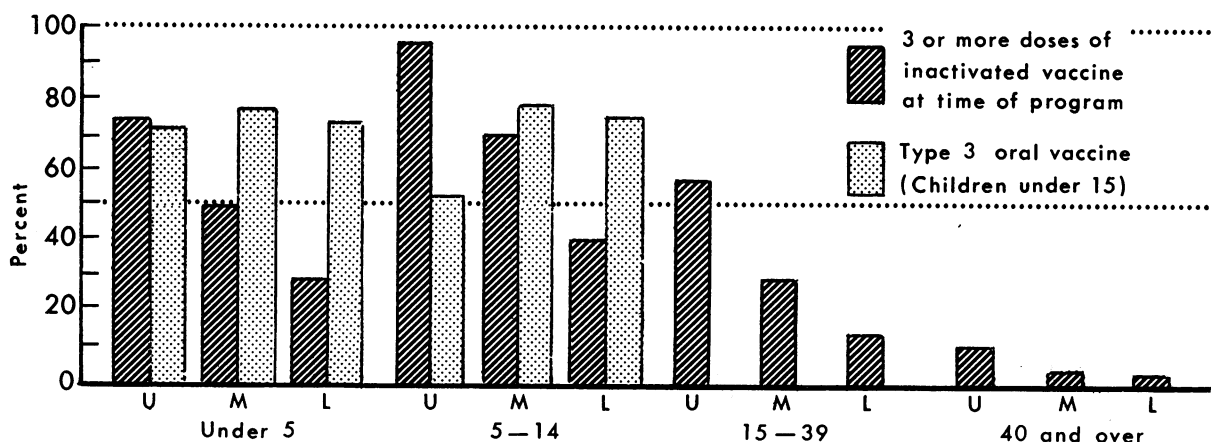
Another factor to be considered in comparing the oral and inactivated vaccine programs is that the oral programs involved only one dose. The falloff in three-dose programs, with either inactivated or oral vaccine, requiring successive visits to clinics is greater in the lower socioeconomic areas.

Results of immunization campaigns in three cities, as measured by sample surveys

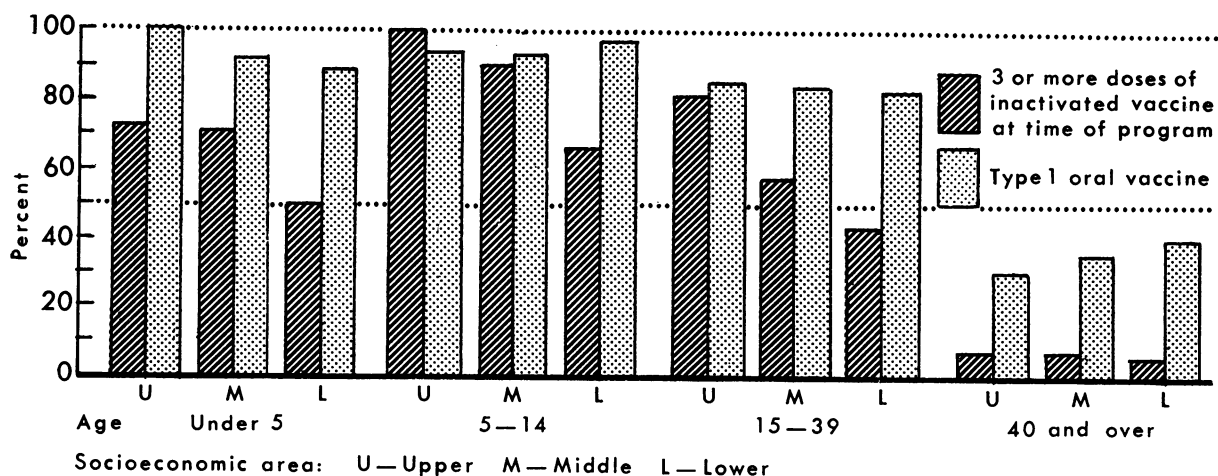
Columbus, Ga., three doses of inactivated poliomyelitis vaccine, April-May 1961



Atlanta, Ga., single dose of type 3 oral poliomyelitis vaccine, June 1961



Syracuse, N.Y., single dose of type 1 oral poliomyelitis vaccine, August 1961



Eight months after the type 3 campaign in Atlanta, types 1 and 2 oral vaccines were distributed, 1 month apart, to the entire population throughout the city. Special programs were centered in certain low socioeconomic census tracts. In one study, handbills were left at each household informing the residents that a mobile van would be in the area the following day to distribute oral type 1 vaccine. The van arrived at the designated times and places and distributed the vaccine to all persons who appeared. A subsequent survey showed that, for children under 5 years of age, response was poorest among those who had not previously received any inactivated poliomyelitis vaccine (table 5). In view of the ease of obtaining the oral vaccine, the low response among previously unvaccinated children was disturbing.

Table 5. Number and percentage of children receiving type 1 oral vaccine, Atlanta, Ga.

Number of inactivated polio vaccine doses	Number of children in sample	Number receiving oral vaccine	Percent receiving oral vaccine
0.....	118	64	54.2
1-2.....	86	73	84.9
3 or more.....	59	44	74.6

In Syracuse, where each case of poliomyelitis occurring in the community was reported in the daily newspapers, a barrage of publicity opened the vaccination program. Location was announced of the 20 schools throughout the city which would serve as distribution points, as well as the centrally located city health department. At the end of the first day it was noted that response lagged at the clinics in the poorer sections of the city in comparison with attendance at clinics elsewhere in the community. Intensified publicity continued. News of the clinics spread from employers to employees in the shops and factories and from housewife to housewife, and interest was stirred by newspaper announcements.

Surveys conducted at the close of the immunization programs revealed the effectiveness of the campaigns and eliminated the necessity of

analyzing voluminous individual registration records. In some instances where the clinics were swamped by persons seeking the vaccine, individual registration was abandoned in order to meet the demand.

In a mass immunization program where attendance is necessary at three successive clinics held a month apart to acquire three doses of oral or inactivated polio vaccine, analysis of registration records becomes increasingly complex and may exceed the capabilities and facilities of local health departments. Simple tallies by observers who record the number of persons attending by broad age groups may serve as guides for intensifying efforts in local areas during the campaign but are of little value in estimating the immunization levels of the population after the campaign.

Summary

Three surveys of immunization levels after mass distribution of poliomyelitis vaccine indicate that estimates by age, socioeconomic area, and number of doses can be obtained rapidly and economically. In the situations described, the threat of an epidemic proved to be a more effective stimulus than the intensive efforts by health department personnel and other civic agencies in a nonepidemic period.

REFERENCES

- (1) Serfling, R. E., Cornell, R. G., and Sherman, I. L.: The CDC quota sampling technic with results of 1959 poliomyelitis vaccination surveys. *Am. J. Pub. Health* 50: 1847-1857, December 1960.
- (2) U.S. Communicable Disease Center: Poliomyelitis Surveillance Report No. 249. Atlanta, Ga., Jan. 5, 1962.
- (3) U.S. Bureau of the Census: Advance table PH-1: Population and housing characteristics, 1960. U.S. Government Printing Office, Washington, D.C., 1962.
- (4) U.S. Bureau of the Census: Census of housing: 1960. Series HC(3)-287. U.S. Government Printing Office, Washington, D.C., 1962.
- (5) Hollingshead, A. B.: Two-factor index of social position. [Privately printed], New Haven, Conn., 1957.